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A METHOD OF ESTIMATING THE ECONOMIC EFFECTS OF PLANNED CONSERVATION ON AN INDIVIDUAL FARM

By ARTHUR C. BUNCE, *assistant professor, Iowa State College, and cooperative agent, Soil Conservation Service*, and GEORGE W. COLLIER, *agricultural economist, Soil Conservation Service* [1]

Soil Conservation Service and Bureau of Agricultural Economics, United States Department of Agriculture, in cooperation with the Iowa Agricultural Experiment Station

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INTRODUCTION

In considering the adoption of soil-conserving methods of farming the farmer is faced with the problem of choosing changes in land use and cropping practices that are most desirable in reducing or preventing soil losses. Several alternative changes may be equally effective. For example, a given field may be terraced and no changes made in the crops grown; it may be strip-cropped, with some increase in close-growing crops; or it may be placed under a more or less permanent vegetal cover. If the various alternatives possible are equally effective in controlling erosion, the best system can be determined only by an analysis of the costs of each proposed plan and its effect upon the farm organization and income. In all cases farmers and others who are formulating farm plans need to consider not only the physical effectiveness of certain measures of control but also their effect upon the farm as a business enterprise. Costs may be affected, net income increased or decreased, and the value of the land altered.

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Consideration of economic factors is important to every farmer, even if he is making only minor changes in his farming operations. It is still more important when he is planning extensive changes. In order that more intelligent decisions may be made, his operation plans should be based upon estimates of expected future results, and although such estimates are tentative, they provide information by which alternative plans may be evaluated, and they indicate the economic implications of changes that may be desirable in controlling erosion.

If a conservation plan is to be acceptable permanently, it must be based on sound farm-management principles. Farm management involves the utilization of land, labor, and capital in a manner to achieve the largest continuous returns over a long period of years. To attain this end careful consideration must be given to the maintenance of the productivity of the land. Farm management and conservation planning are complementary aspects of good farming.

This publication outlines some factors that should be considered and some estimates that should be made in order to determine the probable economic effects of adopting a specific plan of erosion control. Measurement of the effects of changes in farm organization designed to control erosion and maintain soil resources ordinarily involves the making of estimates that will indicate the effect of the new plan on (1) crop production, (2) the livestock adjustments that may be necessary to make the best use of the feed available, (3) the effect on the use of labor, (4) the capital loss resulting from the destruction of soil assets through erosion, (5) the capital outlay, and (6) the effect on annual net income.

No attempt has been made to evaluate separately the effects of specific erosion-control measures, such as terracing or changes in land use, from the effects of other practices, such as the use of lime and fertilizer, that may be included in a conservation plan. A limitation in the determinations, therefore, lies in the fact that some measures may be beneficial and others detrimental to the whole organization. The practicability of measuring the effects of individual practices is generally restricted by the dependence of one practice upon another and by the complementary nature of benefits and costs of the combination of practices. Where possible, however, the effects of specific elements of a plan should be evaluated separately.

A farm that has adopted a program of soil conservation has been selected for illustration of a method of estimating the economic effects of planned soil conservation in farming. The farm was not chosen as being representative of any group of farms in any area, but was selected as a means of developing a method of analysis that may be used to estimate the results of a variety of changes in farm organization. Estimates of yields, costs, and returns will vary for each farm, and in all cases local cost and price figures should be used.[2]

The purpose of this publication, then, is to present a method of making these estimates—a method that can be used by farmers and others who are interested in evaluating the implications of alternative farm plans upon farm income.

Tables are presented to show how estimates for the proposed system for the farm under consideration compare with records of its past

[2] While the illustrated material in this publication refers particularly to the Corn Belt, the principles used in the analysis apply equally to other parts of the country and other types of farming.

performance. Figures are given only for items that affected the income for this farm; other items listed in some of the tables are included as suggestions for other farmers. The data showing conversion values, included in the appendix, should be helpful to the planner in making estimates insofar as they are applicable to the conditions under consideration.

CHANGES IN CROP PRODUCTION

Several important factors must be kept in mind in determining the changes in cropping system that will result from the adoption of a soil-conservation program. Physical conditions, including type of soil, degree and length of slope, and degree of erosion usually constitute the physical basis for tentative decisions regarding the land to be used in crop production, the rotation of crops, and the cropping practices. Changes in the cropping system affect the kind and quantities of cash crops and feed produced.

Regular use of lime and fertilizer often is the largest item increasing annual costs, and it may be a significant factor in increasing yields.

Rotations, including the use of more leguminous crops that can be turned under as green manure, tend to increase the organic matter in the soil and increase its water-holding capacity. Terracing, contour farming, and strip cropping slow down run-off and increase infiltration of water. Retiring the poorest cropland to permanent pasture or woodland increases average yields per acre of specific crops if no other factors are considered.

The actual increase in yields will depend on the treatments and practices included in the new plan, the soil condition, and the yields obtained under the old system. If yields have been maintained at a high level in the past, large increases cannot be expected. Where past yields have been very poor, soil treatments and proper rotations may bring about large increases.

One of the most difficult estimates to make is that of the carrying capacity of an acre of pasture. This differs considerably between areas because of differences in the kind of grasses and legumes sown, soil type, amount and distribution of precipitation, treatments such as disking, liming, fertilizing, and weed cutting, and the care with which the pasture is grazed.

A pasture-day is defined as the amount of pasture that is consumed by a mature cow in 1 day, with no other feed available, and at least maintains the weight of the animal. Pasturage of other classes of livestock is measured on this basis. Pasture-day equivalents for other animals are listed on page 26.

If, for example, it takes 3 acres to pasture 1 cow, and livestock can be kept on pasture, with very little additional feed, during April, May, June, September, October, and November, then 1 acre of the pasture is yielding one-third of a pasture-day for 182 days, or a total of approximately 61 pasture-days per year. If it takes only 2 acres per cow and pasture is provided for 200 days, then the yield would be 100 pasture-days per acre per year.

If fields or strips are fenced, rotation hay and pasture may be used interchangeably to meet the needs of the livestock kept. A rough estimate of the yield of some rotation pastures may be made by multiplying the estimated yield of the pasture if cut for hay by the

feed-unit value of such hay, as shown in table 13[3]—Feed-unit equivalents of specific feeds—and translating this figure into pasture-days by multiplying by 4 (4 pasture-days=1 feed unit). Thus, if a legume pasture would have yielded 2 tons of hay per acre at 18 feed units per ton, the 36 feed units would be equivalent to 144 pasture-days.

In estimating the carrying capacity of pasture care should be taken to see that they are conservative and based upon the past experience of the farmer, who generally knows approximately how many acres are needed under prevailing conditions for 1 cow.

TABLE 1.[1]—*Changes in land use and crop production*

Crop	Old system			New system			Total change in production	
	Acreage	Estimated production		Acreage	Estimated production		Quantity	Feed unit
		Per acre	Total		Per acre	Total		
Grain:	*Acres*	*Bushels*	*Bushels*	*Acres*	*Bushels*	*Bushels*	*Bushels*	*Number*
Corn	40	37	1,480	25	42	1,050	−430	−430
Oats	40	30	1,200	25	34	850	−350	−175
Total	80			50				−605
Silage		*Tons*	*Tons*		*Tons*	*Tons*	*Tons*	
Legume hay:								
Alfalfa	11	1.8	19.8	20	2.0	40	+20.2	+364
Clover and timothy								
Total	11	1.8	19.8	20	2.0	40	+20.2	+364
Other hay and roughage:								
Timothy and clover	8	1.1	8.8	14	1.2	16.8	+8.0	+120
Oat straw	40	.5	20.0	25	.5	12.5	−7.5	−38
Corn stover								
Total	48			39				+82
Pasture:		*Pasture-days*	*Pasture-days*		*Pasture-days*	*Pasture-days*	*Pasture-days*	
Permanent	32	60	1,920	46	70	3,220	+1,300	+325
Sweetclover				14	100	1,400	+1,400	+350
Timothy and clover	8	70	560	16	75	1,200	+640	+160
Idle cropland	25	10	250				−250	−62
Cornstalk pasture	40	12	480	25	12	300	−180	−45
Total	105		3,210	101		6,120	+2,910	+728
Wood lot, buildings, roads	4			8				
Total in farm [2]	168			168				[3] −605 [4] +1,174

[1] Blank sets of all tables used in this publication may be obtained by writing to the nearest regional (page 28) or field office of the Soil Conservation Service.

[2] In totaling acres, acreage for oat straw and cornstalk pasture should not be added, since these are included under grain.

[3] Concentrates.

[4] Roughage.

The acreages and yields of crops and pasture under the old system and estimates under the proposed system for the farm studied are shown in table 1. Past acreages and yields are based upon the aver-

[3] Tables 13 to 15, inclusive, are shown in the Appendix.

ages of a number of years. The differences in production under the two systems are shown both in physical quantities and in feed units. The feed units are calculated from table 13. The changes in feed units are shown by classes of feed—grain, hay, other roughage, and pasture. Changes in total concentrates and roughage feed units are also shown.

The table shows that on this farm with the proposed changes concentrates would be reduced by 605 feed units and roughage increased by 1,174 feed units. The total of all feed would be increased by 569 units. These figures are useful in indicating the direction of desirable changes in the livestock system.

EFFECT OF CHANGES IN CROP PRODUCTION ON THE LIVESTOCK SYSTEM AND FARM INCOME

Changes in the kind, acreage, and management of crops may affect the organization of a farm in several ways. A decrease in production of grain may reduce sales of grain or production of grain-consuming livestock. An increase in production of legumes may make it possible to plow under some as green manure or feed the increase to additional roughage-consuming animals. Decrease in grain and increase in roughage may result in no change in livestock production where there is opportunity to adjust the rations of the livestock to the changed feed supply. Improvement in quality of roughage, even though the quantity fed remains unchanged, may increase livestock production. Any one of these changes in crop production may have important effects on farm costs and income through its effect on the livestock system.

Several common alternative adjustments may be made in the livestock system by the farm operator:

1. To some extent, the rations fed to various classes of livestock may be modified and a part of the concentrated feeds replaced by high-quality roughage; the extent to which this is possible will depend largely upon the previous methods of feeding, for where large quantities of roughage are already included in the ration very little substitution will be possible.

2. Where concentrated feeds, such as corn, have been reduced, fewer concentrate-consuming animals, such as hogs, may be kept, or more concentrates may be purchased and the same number of these animals fed.

3. Beef cows, feeder cattle, dairy cows, or sheep may be increased to utilize increases in roughage.

When considering what changes should be made, the farmer's past experience and personal preference should be considered, and where possible, expansion of some of his present livestock enterprises or the adoption of new enterprises that do not involve specialized techniques are preferable to the introduction of livestock enterprises with which he is unfamiliar. Available labor must also be taken into account.

Estimating the effects of a changed livestock system of necessity requires the recognition of differences in the efficiency of farmers in feeding operations. Differences of more than 100 percent have been recorded in the amount of gain per 100 pounds of feed fed. Care must be taken not to assume the most efficient management, but rather to base the estimates on the expected efficiency of the farmer. Weak-

nesses in past feeding practices may be revealed and corrected, so that the efficiency of the farm unit may be increased apart from any change in feed production. The total quantity of feed fed on a farm does not indicate how the feed was used. Some classes of livestock may have been fed very efficiently, while for others the feeding may have been inefficient; however, when the total feed fed is compared with the total feed quantities calculated from standards of feeding, an index of the average feeding efficiency is obtained.

More accurate estimates of changes planned in livestock numbers to utilize a changed feed supply can be made if detailed records of past production of crops, sales and purchases of grain and feeds, production of livestock, and quantities of feed fed to specific classes of livestock are available. The quantity of concentrates and roughage consumed per 100 pounds of gain in weight or per 1,000 pounds of milk produced or in relation to other units of production can then be compared with recommended feeding standards to aid in planning the new livestock system. Such records would also furnish a good basis for estimating the possibilities of feed utilization by livestock in a soil-conserving system of land use.

On most farms, however, such detailed information is not available, and there is need for a simplified method of anticipating the kinds and number of livestock that are best adapted to changed cropping systems. While the following method may be less nearly adequate than that just discussed, because it is based on less detailed information, it may be more useful because it can be used on farms where detailed records have not been kept.

A farmer who knows approximately the quantities and kinds of feed fed to the specific classes of livestock kept can make direct entries on a table similar to table 2. If this is done, the calculation of feed quantities from standard tables and the conversion of all feeds into feed units will not be necessary. This simplifies the calculations involved in balancing the new feed production with the new livestock system.

To estimate the effects of changes in crop production upon livestock and income on his farm, the farmer should take the following five steps:

1. Calculate the total feed fed under the old system, and record as illustrated in table 2. The total crops produced, plus all feed purchased, and minus all crops sold represents the total amount of feed fed on the farm. The accuracy of this figure depends largely upon the estimates of total production, recorded as in table 1.

2. Calculate and total the standard feed quantities for the livestock kept on the farm under the old system and record as in table 2, using the data from table 14—Standard feed quantities for livestock—or from other applicable sources.

3. Compare the actual feed fed with the calculated standard feed quantities. This will indicate roughly whether adjustments in rations are possible and in what direction they may be made. Some variation in feeds used is permissible because of the possibility of substituting concentrate and roughage feeds for each other. This range of substitution depends upon relative prices and physiological factors and varies considerably for different kinds of livestock. For horses, dairy

cows, beef cattle, and sheep it appears rather wide, but for concentrate-consuming animals, such as hogs and poultry, the range of substitution is relatively narrow.

To estimate how much of one feed should be used when substituted for another it is helpful to convert all feed quantities into feed units. The feed value of 1 bushel of corn represents one feed unit, and all other feeds are expressed as equivalents of 1 bushel of corn. These equivalents are given in table 13.

In making changes in the rations, the need of feeding a balanced ration must be considered carefully. Table 15 gives the probable range of substitution between roughage and grain feed units for specific classes of livestock.

Feed units are useful also in comparing the total feed fed under the old system with the feed quantities as calculated from standard tables. This comparison will indicate whether the farmer is wasting feed as a result of unbalanced rations or poor feeding practices. Past feeding efficiency must be taken into account, as explained previously, when the proposed livestock system is adjusted to the feed available under the proposed cropping system, so that the mistake of estimating livestock numbers by fitting standard feed quantities to the new feed production may be avoided.

If the analysis of the past feeding system shows that the farmer was feeding 4,000 feed units where the calculated units were only 3,000, then the feed allowed for the proposed livestock system should be approximately one-third larger than would be indicated by the feed quantities calculated from the standard tables. In some cases, it may be reasonable to assume more efficient livestock management in the future, if analysis of past feeding practices shows that the changes in organization will provide more nearly balanced rations. No changes in efficiency, however, should be assumed unless it can be shown that such changes probably will take place.

4. The fourth step is to estimate the kinds and numbers of livestock that will best utilize the feed produced under the proposed cropping system, at approximately the same level of efficiency as was shown in the past. This step is shown in table 3. The changes in production, recorded as in table 1, may be used as a guide in making a preliminary determination of these changes. The expected feed consumption may then be calculated for the new livestock system and purchases and sales of feed adjusted to the new organization. Both livestock numbers and purchases and sales of feed are flexible, and either may be adjusted as long as the ratio of available feed units to the feed units computed from standard tables remains the same.

5. The final step consists of estimating the changes in income resulting from the changes in sales and purchases of grain, feeds, and livestock. Tables, 2, 3 and 4, and the following discussion and tables present these calculations in detail for the farm that is being used as an example. Table 2 summarizes crop production, purchases, sales, feed fed, and the standard feed quantities for the livestock kept. These quantities were converted into feed units by using the factors given in table 13.

TABLE 2.—*Available feed, feed fed, and standard feed quantities for livestock, kept, old system*

Kind of feed	Feed available					Standard feed quantities for livestock kept														
				Fed		Total required		Horses, 2 years or over	Dairy cattle			Beef cattle		Sheep		Hogs			Poultry	
	Production [1]	Sold	Bought	Quantity	Feed units	Feed units	Quantity		Bulls	Cows, under 5,000 pounds, milk	Calves, to 1 year			Ewes	Lambs	Sows	Spring pigs [2]	Fall pigs [2]	Laying hens	
Animals								*No.* 2	*No.*	*No.* 4	*No.* 2	*No.*	*No.*	*No.* 50	*No.* 50	*No.* 3	*No.* 20	*Np.* 20	*No.* 50	
Grain:	*Bu.*	*Bu.*		*Bu.*			*Bu.*	*Bu.*	*Bu.*		*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bo.*	*Bu.*	
Corn	1,480	200		1,280	1,280	864	864	40		48	16			50	50		300	320	40	
Oats	1,200	200		1,000	500	263	526	70		52	16			100	190		40	60	88	
Total					1,780	1,127														
			Lb.	*Lb.*			*Lb.*				*Lb.*					*Lb.*	*Lb.*	*Lb.*	*Lb.*	
Protein feeds:			400	400	8	76	3,800				200						1,400	1,800	400	
Total			400	400	8	76	3,800				200						1,400	1,800	400	
	Tons			*Tons*			*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*					
Silage																				
Legume hay:																				
Alfalfa	19.8			19.8	356	522	29	3		10	2			13	1					
Clover and timothy																				
Total	19.8			19.8	356	522	29	3		10	2			13	1					

[1] Production of 1918 crop.

[2] Spring pigs farrowed in 1919; fall pigs farrowed in 1918.

Other hay and roughage:																				
Timothy and clover	8.8			8.8	132	30	2	2												
Oat straw	[3] 20			10.0	50															
Corn stover																				
Total	28.8			18.8	182	30	2	2												
	Pasture-days			*Pasture-days*			*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*		
Pasture:																				
Permanent	1,920																			
Sweetclover																				
Timothy and clover	560																			
Idle cropland	250																			
Cornstalk pasture	480																			
Total	3,210			3,210	802	883	3,534	320		720	44			1,800	450		200			
Total feed units					3,128	2,638														
Ratio of feed fed to feed standards					119	100														

[1] From table 1.
[2] Includes feed for brood sows.
[3] Includes straw used for bedding.

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TABLE 3.—*Available feed, feed fed, and standard feed quantities for livestock to be kept, proposed system*

Kind of feed	Feed available					Standard feed quantities for livestock to be kept													
				To be fed		Total required			Dairy cattle			Beef cattle		Sheep		Hogs			Poultry,
	Production [1]	Sold	Bought	Quantity	Feed units	Feed units	Quantity	Horses 2 years or over	Bulls	Cows under 5,000 pounds milk	Calves, to 1 year	Stocker yearlings		Ewes	Lambs	Sows	Spring [2] pigs	Fall [2] pigs	Laying hens
Animals								*No.* 2	*No.*	*No.* 4	*No.* 2	*No.* 10	*No.*	*No.* 57	*No.* 57	*No.* 3	*No.* 20	*No.* 20	*No.* 50
Grain:																			
Corn	*Bu.* 1,050	*Bu.*		*Bu.* 1,050	1,050	898	*Bu.* 898	*Bu.* 40	*Bu.*	*Bu.* 48	*Bu.* 16	*Bu.* 20	*Bu.*	*Bu.* 57	*Bu.* 57	*Bu.*	*Bu.* 300	*Bu.* 320	*Bu.* 40
Oats	850	200		650	325	297	594	70		52	16	40		114	114		40	60	88
Total					1,375	1,195													
Protein feeds			*Lb.* 400	*Lb.* 400	8	76	*Lb.* 3,800				*Lb.* 200					*Lb.*	*Lb.* 1,400	*Lb.* 1,800	*Lb.* 400
Total			400	400	8	76	3,800				200						1,400	1,800	400
Silage	*Tons*			*Tons*			*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*				
Legume hay:																			
Alfalfa	40			40	720	720	40	3		10	2	10		14	1				
Clover and timothy																			
Total	40			40	720	720	40	3		10	2	10		14	1				

Other hay and roughage:																			
Timothy and clover	16.8			16.80	252	180	12	2				10							
Oat straw	[3] 12.5			6.25	31														
Corn stover																			
Total					283	180	12	2				10							
Pasture:	*Pasture-days*			*Pasture-days*			*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	*Pasture-days*	
Permanent	3,220																		
Sweetclover	1,400																		
Timothy and clover	1,200																		
Idle cropland																			
Cornstalk pasture	300																		
Total	6,120			6,120	1,530	1,112	4,449	320		720	44	600		2,052	513		200		
Total feed units					3,916	3,283													
Ratio of feed fed to feed standards					119	100													

[1] From table 1.
[2] Includes feed for brood sows.
[3] Includes straw used for bedding.

Table 2 shows that the operator on this farm used 3,128 feed units and that the standard feed quantities required for the number of livestock kept totaled 2,638 feed units. The ratio of feed fed to the feed standard was 1.19 to 1, which shows that this farmer was feeding approximately 19 percent more feed than was considered necessary according to feeding standards. The table also shows that much more grain was fed than was indicated by the standards and that the rations were deficient in legume hay, protein feeds, and pasture. Although an increased quantity of pasture and legume hay may result in a more efficient use of feed, no increase in efficiency has been assumed.

The prices of various feeds should be taken into account when considering the question of feeds to be bought or sold. The suitability of specific kinds of grains, roughages, and protein concentrates to the needs of specific classes of livestock should also be considered.

The next step is to determine the changes in the livestock system necessary to adjust it to the new feed production. On the farm under consideration the roughage has been increased considerably. Apart from the additional pasture, which can be used by the present stock, more roughage-consuming animals will be needed. These could be dairy cows, sheep, or beef cattle.

In this particular case the farmer wished to utilize his increased roughage and pasture by increasing his sheep and by keeping some yearling steers. To determine the approximate numbers that could be fed on the increased roughage, the expected purchases and sales of feed stuffs were entered tentatively in table 3, the feed units available calculated from table 13, and the total of 3,916 feed units under the proposed system compared with the total of 3,128 feed units available under the old system. The difference between these two figures shows an increase of 788 feed units available under the new system.

Since the farmer was feeding 19 percent more feed than was necessary as indicated by the standards, the 788 feed units would feed, at the same level of feeding efficiency, only as many animals as could be fed by 663 (788÷1.19) feed units. Table 14 shows that 1 ewe and 1 lamb use 20.2 feed units and that 1 stocker yearling uses 52. This indicates that the 663 feed units could be used to feed 33 ewes and lambs or 13 stocker cattle. The farmer decided to purchase 10 stocker yearling steers and increase his sheep by 7 ewes and lambs. The cattle would use 520 feed units and the sheep and lambs 141 or the additional livestock would consume a total of 661 units of feed.

Once the changes have been decided upon, the new numbers of livestock, feed quantities and units to be fed, and standard feed quantity units should be entered in on a table similar to table 3. The ratio between the total feed units available and the standard feed units calculated should be the same as that under the old system, if no change in feeding efficiency is anticipated.

After the new livestock system has been adjusted to the changed feed situation, the estimated effect of changes in purchases and sales of feed, grain, and livestock on income should be shown on a table, as in table 4. The simplest method is to list only the changes that are expected to occur under the proposed system. Local prices should be used in estimating changes in income. Where the current local price of any particular product is abnormally high or low, the use of 5- or 10-year averages may give a more accurate picture. The sum

of these changes will show the probable net effect on the total farm income.

TABLE 4.—*Estimated effect on income of changes in purchases and sales of crops, feeds, and livestock*

Item	Old system	Proposed system	Difference	Unit value	Net effect on income	
					Increase	Decrease
Purchases:						
Feed:	*Pounds*	*Pounds*	*Pounds*	*Dollars*	*Dollars*	*Dollars*
Protein feed	400	400				
Livestock:	*Number*	*Number*	*Number*			
Stocker yearlings, 500 pounds		10	+10	37.50		375.00
Sales:						
Crops:	*Bushels*	*Bushels*	*Bushels*			
Grain:						
Corn	200		—200	.50		100.00
Oats	200	200				
Livestock:	*Number*	*Number*	*Number*			
Beef steers, 700 pounds		10	+10	56.00	560.00	
Old ewes, 150 pounds	10	11	+1	5.25	5.25	
Lambs, 80 pounds	40	46	+6	5.60	33.60	
Spring pigs	20	20				
Fall pigs	20	20				
	Pounds	*Pounds*	*Pounds*			
Wool	350	399	+49	.25	12.25	
Total					611.10	475.00
Net effect on income					136.10	

Other factors to be considered are the changes in income resulting from the use of land for other production, such as woodland. Four acres of black locust have been planted on the example farm and in 10 years will yield an expected return of $5 to $10 an acre. Although this will add to the value of the farm as the trees develop, no present income can be expected.

The total net effect of these changes (table 4) upon income should be carried forward and entered on a table similar to table 12. Any changes in investment in livestock that are associated with the new plan should be entered on a table similar to table 11, under the heading changes in operating capital. The changes in numbers of livestock representing permanent investment can be obtained from tables similar to tables 2 and 3, by comparing the old and the proposed livestock systems. Average local prices should be used to determine the value of the changed investment in livestock.

EFFECT OF CHANGES IN CROP PRODUCTION AND LIVESTOCK ON THE USE OF LABOR

Changes in acreages of specific crops, cropping practices, and the kind and number of livestock kept may influence the total labor used and its seasonal distribution. It is important to determine whether the changes in crop and livestock systems will make it necessary for the farmer to hire more or less labor. If no change in the amount of labor to be hired is anticipated, changes in labor performed by the farmer or his family should be given dollar value only when there are

alternative opportunities for its use. If the appraisal shows that the proposed system reduces labor by 10 days but that the farmer ordinarily hires labor by the month and that the outlay for this hired labor could not be reduced by the proposed changes, then no reduction in labor expense should be assumed. If an increase in use of labor is indicated, it should not be charged as a cash expense unless there is an actual increase in hired labor or additional labor of the farmer and his family lessens the possibilities of their income from other sources. Changes in farm organization in use of labor at peak periods will have more influence on the amount of labor hired than will the change in total man-hours for the year.

Many farmers will prefer to estimate changes in labor costs under the proposed system without estimating changes in man-hours. For instance, if the acreage of hay were doubled, the farmer could estimate from the availability of family labor, regularly hired labor, and exchange labor, from the size of crew needed, and from probable effect on other seasonal operations how much additional labor he would need to hire if he made the proposed changes in organization. If changes in labor costs can be estimated directly, they can be entered in the total column of a table, similar to table 5, without showing the monthly differences in man-hours.

If information is available concerning seasonal labor used for specific crops and classes of livestock and total labor available at peak periods, monthly distribution of labor changes as shown in table 5, will help to make a more nearly accurate estimate of changes in hired labor and chargeable farmer labor. Labor needed per head of specific classes of livestock, as shown in the tabulation at the bottom of page 26, and local information on labor used in crop production will be helpful in making quantitative estimates of labor changes.

Estimates indicate that labor used for crop production on the example farm (table 5) will be reduced 123 hours, while the labor used for livestock will be increased 417 hours. This raises the question as to whether the net increase of 294 labor hours, 29½ man-days, can be met by the farmer's usual labor supply, and also whether the seasonal distribution of labor will be altered. The work necessitated by the increase in alfalfa hay could conflict seriously with the cultivation of corn and harvesting of oats, but since the acreage in both oats and corn is greatly reduced, it was felt that there would be no need to employ more labor during the haying periods.

During the fall, winter, and early spring sufficient labor is available to care for the extra stock, so that no extra help will be needed during this period. In brief, the suggested changes in the livestock system are such that the largest increase in labor occurs when there is no field work to be done; once on pasture the stocker cattle and sheep demand a relatively small amount of care. These changes are more fully shown in table 5.

Apart from changes in production, changes in farm practices also may affect the use of labor. Terracing, contour farming, and strip cropping may change the labor hours per acre of crop; maintenance of terraces, outlets, and temporary dams may demand additional labor. No figures are available for general guidance because of the wide variations of conditions on each farm. As reported in an Iowa study,[4]

[4] BUNCE, ARTHUR C. THE FARMER LOOKS AT SOIL CONSERVATION IN SOUTHERN IOWA. Iowa Agr. Expt. Sta. Bul. 381, pp. 117–163, illus. 1939. See pp. 124–126. 1939.

TABLE 5.—*Changes in annual and seasonal labor resulting from changes in crops harvested and livestock fed*

Item		Man-hours													
		Per unit	Total	January	February	March	April	May	June	July	August	September	October	November	December
Crops:	*Acres*														
Corn	−15	10	−150				−15	−30	−30	−15			−30	−30	
Oats	−15	6.2	−93			−9	−19			−28	−37				
Silage															
Alfalfa	+9	10	+90						+36	+24	+18	+12			
Clover and timothy	+6	5	+30							+10	+20				
Other hay and roughage															
Total			−123			−9	−34	−30	+6	−9	+1	+12	−30	−30	
Livestock:	*Head*														
Horses															
Dairy cattle															
Beef cattle, stocker	+10	40	+400	+60	+60	+60	+20			+20	+20	+20	+40	+40	+60
Sheep	+7	2.5	+17	+3	+3	+3	+4	+4							
Hogs															
Poultry															
Total			+417	+63	+63	+63	+21	+4		+20	+20	+20	+40	+40	+60
Net change			+294	+63	+63	+54	−10	−26	+6	+11	+21	+32	+10	+10	+60
Extra labor [1] to be hired															
Cost [1]															

[1] Text explains why no labor is hired.

more than half of the farmers with terraced, strip-cropped, or contoured fields have stated that these practices had not changed their labor demands. On terraced fields, 43 percent reported an increase and 5 percent a decrease in labor; on strip-cropped and contoured fields, 34 percent reported an increase and 13 percent a decrease in labor used.

In making labor estimates, length of rows, size of field, width of strips, and distance between terraces are important factors. One 37-acre field of the example farm has been terraced and will be farmed on the contour with five strips. The two terraces run across the field, so that the average length of rows will not be altered materially.

More labor may be used during the first year because the farmer is not accustomed to working on the contour, but, after he has become more experienced, no significant increase in labor should result from changes in cropping practices. The grassed waterways and sod dams on the farm may demand some attention, however, this labor is offset by a saving in time previously spent in attempting to control the gullies with brush and straw.

If additional labor is to be hired, the cost should be estimated at local rates of pay and the total carried forward to the final balance sheet (table 12).

COST OF ACHIEVING CONTROL OF EROSION

The cost of controlling erosion will vary with the seriousness of the conditions that have developed and the means used to remedy them. This cost can be divided into the following classes:

1. Nonrecurring costs or capital expenditures:

   (*a*) Direct capital outlay for terracing, building, rebuilding, and moving fences, establishing permanent pasture and woodland, grassing waterways, contour furrowing, sloping gully banks, and constructing gully-control dams, diversion ditches, and other permanent work.
   (*b*) Indirect capital outlay required by the adjustment of the farming system to the new cropping system. This may involve expenditures for buildings, livestock, farm machinery, or other equipment in order to operate the farm more efficiently under the new plan.

2. Annual recurring costs or changes in operating costs:

   (*a*) Net changes in labor costs and changes in net farm income resulting from the effects of the program upon the sales and purchases of crops, feeds, and livestock. These have already been discussed.
   (*b*) Changes in current costs directly associated with changes in the crops produced. These changes in crop expenses result from changes in the acreages to be seeded to grass and legumes each year, changes in the applications of lime and fertilizer, changes in cash harvesting expenses, and other miscellaneous changes in costs, such as tractor fuel and veterinary expenses.

In estimating these costs of achieving erosion control it is necessary to estimate the capital outlay and place this on an amortization basis, so that it can be included as an increase in annual cost. For the recurring costs only expected annual changes from the old system need be considered. To make these estimates the past cropping system must be compared with that to be established under the new conservation plan. Estimates of costs of such permanent work as terracing and building dams should be obtained from the most accurate sources of information.

In some cases several alternative plans for erosion control may be possible, and estimates showing the final results on income for each plan should be prepared in order to compare their probable economic effects. It must necessarily be assumed that the alternatives are equally effective in controlling erosion and that the complete conservation program will place the farm on a permanent production basis, so that further capital loss from soil erosion is eliminated.

The estimated changes in annual seed costs should be recorded as shown in table 6. The change in acreage of specific crops is obtained by comparing the acreage of each crop listed under the old and under the proposed systems (table 1). Local prices should be used for the cost per unit of seed. The cost per acre is obtained by multiplying the quantity of seed per acre by the cost per unit. The change in annual cost of seed is obtained by multiplying the change in acreage by the cost per acre and dividing by the number of years between seedings.

TABLE 6.—*Estimated changes in annual seed costs*

Crop	Change in acreage [1]	Years between seedings	Quantity per acre	Cost per unit	Cost per acre	Change in total cost
	Acres	*Number*	*Bushels*	*Dollars*	*Dollars*	*Dollars*
Corn	−15	1	0.15	1.00	0.15	−2.25
Oats	−15	1	3	.35	1.05	−15.75
			Pounds			
Alfalfa	+9	5	15	.33	4.95	+8.91
Sweetclover	+14	2	10	.10	1.00	+7.00
Red clover		5	8	.33	2.64	+7.39
Timothy	[2]+14	5	4	.044	.18	+.50
Net change						+5.80

[1] Taken from table 1. [2] Mixture of red clover and timothy on 14 acres.

TABLE 7.—*Estimated changes in annual miscellaneous costs*

Item	Amount of change		Cost per unit	Change in total cost
	Increase	Decrease		
Harvesting: [1]	*Bushels*	*Bushels*	*Dollars*	*Dollars*
Oat threshing		−350	0.025	−8.75
Other costs: [2]				
Net change				−8.75

[1] Enter labor costs here for such items as combining, threshing, or corn picking only if they are included in the rate to be charged for the harvesting operation. Any differences in harvesting costs that are specifically for labor should be entered in table 5.
[2] Such as other livestock expenses, tractor fuel, and machinery repairs.

Table 7 shows how the changes in the miscellaneous costs of harvesting and other expenses arising from the new plan are entered in the estimates. Changes in hired labor costs associated with harvesting were considered in the discussion of table 5 and should not be duplicated here.

If the cropland is reduced, a reduction in machinery repairs and tractor fuel may result. Where corn or other intertilled crops are replaced by small grain and hay crops, costs for some machines may be increased, while others may be decreased. These changes should be recorded as in table 7. The extent of these differences will depend upon the machinery being used on each particular farm and the changes made necessary under the proposed system.

On the example farm it was assumed that items of machinery repair that would be increased by the proposed plan would be offset by other items that would be decreased. The net changes in tables 6 and 7 are entered in table 11, under operating capital, and in table 12.

Expected changes in annual costs of lime and fertilizer for the farm are shown in table 8. The net change in these costs represents a combination of capital outlay and recurring costs planned in order to establish the conservation program. On this farm the new system called for the liming and fertilizing of 10 acres every year; in addition, 20 acres were to be limed and fertilized the first year in order to obtain good stands of grasses and legumes, but this was not to be repeated each year. The total costs of items under this heading that represent

capital outlays, and are not costs recurring each year, were carried forward in table 11, as capital investments; changes in recurring annual costs were recorded as changes in operating capital (table 11). Net change in these annual costs was also carried forward (table 12).

TABLE 8.—*Estimated changes in annual costs of lime and fertilizer resulting from the conservation program* [1]

Item	Acres	Quantity per acre	Cost per ton	Total cost	Interest at 5 percent [2]	Cost plus interest	Years available	Annual cost
Capital outlay:		*Tons*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Number*	*Dollars*
Lime	20	3	1.50	90.00	22.50	112.50	10	11.25
Fertilizer	20	.1	27.00	54.00	5.40	59.40	4	14.85
Recurring costs:								
Lime	10	2	1.50	30.00			(3)	30.00
Fertilizer	10	.1	27.00	27.00			(3)	27.00
Total annual cost under proposed system								83.10
Total annual cost under old system								0.00
Net change in annual costs of lime and fertilizer								+83.10

[1] The initial cost of applications of lime and fertilizer should be amortized over the period of their effectiveness to obtain the annual cost. The lime and fertilizer that are to be applied annually represent current operating costs and should not be amortized.

[2] For amortized items multiply one-half the total cost by the rate of interest by the number of years available.

[3] Annual.

In estimating the capital costs of any particular program we need to know how much the initial capital outlay will be and also what this represents as an annual cost when interest and repayments over a period of years are calculated. In general, capital investments are amortized over their expected life. When the investment is maintained by repairing any deterioration as soon as it occurs, then the amortization charge may be looked upon as the cost of upkeep. When upkeep costs are entered as an annual expense only interest on capital outlay need be charged.

For the example farm it was assumed that the labor for building sod dams, building and moving fences, and seeding permanent pasture would be performed by the farmer during slack periods and that labor as well as equipment for terracing and tree planting would be hired (table 9). The charge for permanent pasture represents only the cost of seed; for grassed waterways the cost of grading and seeding were charged; and for tree planting, the cost of 1,000 black locust trees per acre at $2.00 per 1,000 trees and $8.00 per acre for labor was included.

The adequacy of the present farm buildings for the use of additional livestock is important in a consideration of capital outlays. In some cases new sheds may be needed for an increase in roughage-consuming animals; in others the existing buildings may be sufficient. Where new buildings are made necessary under a proposed plan, their costs should be recorded as in table 9. On the farm considered there is no shed that can be used as winter shelter for the 10 head of stocker cattle. Based on a requirement of 30 square feet of shelter per head, an open shed, 15 by 20 feet, should be erected. The cost of such a shed was estimated at $200 (table 9), although this figure would vary widely with the kind of construction and materials used.

TABLE 9.—*Estimated annual costs of capital outlays needed to establish the new system* [1]

Item	Units needed	Unit cost	Total cost
	Number	*Dollars*	*Dollars*
Terraces—miles	1	48.00	48.00
Dams, permanent—number			
Sod dams—do	4		
Diversion ditches—feet			
Sloping gully banks—square yards			
Contour-furrowing—acres			
Fences, new—rods	80	.60	48.00
Fences, moved—do	80	.10	8.00
Fences, rebuilt—do			
Permanent pasture—acres	24	2.50	60.00
Grassed waterways—do	1	10.00	10.00
Trees planted—do	4	10.00	40.00
Cattle shed for yearlings, 15 by 20 feet—number	1	200.00	200.00
Machinery:			
Other equipment			
Total capital outlay			414.00
Amortization interest for 20 years at 5 percent			207.00
Total charge over 20 years			621.00
Annual amortization charge			31.50

[1] Labor costs for any of the above items should be charged only when the labor must be hired or when the use of the farmer's labor actually prevents him from earning cash income at some other work. Similarly, materials obtained from the farm need not be included as a cost unless they represent products that would otherwise be sold.

Another factor that may be important on farms where large changes in the cropping system are made is the effect of the proposed system on the machinery and equipment used. If additional machinery or equipment are necessary, the additional capital outlay should be recorded as in table 9. On this farm no changes in equipment were needed.

The total capital outlay and the annual amortization charges for additional structures and other permanent charges under this heading should be carried forward (tables 11 and 12 respectively).

ESTIMATED CAPITAL LOSS RESULTING FROM SOIL EROSION

Productivity of the soil is one of the most important factors influencing the value of agricultural land. Soil loss consequent to erosion results in reduced productivity and capital loss. Estimates of this capital loss are essential to a determination of the economic value of soil conservation in farming.

Data reported in a recent bulletin [5] show that yields in humid areas vary directly with depth of surface soil, to 8 or 10 inches. Beyond this depth the relationship does not continue. In semiarid regions where the available moisture is the major limiting factor, the relationship may not hold true or may continue far beyond 8 or 10 inches.

Surface soil is lost through sheet erosion. The difference between the present value of the land and its value if soil erosion continues until all the topsoil is lost represents the total capital loss that will result from continued sheet erosion. Apart from reducing the depth of surface soil and lowering yields, erosion may lower the value of

[5] MURRAY, WILLIAM G., ENGLEHORN, A. J., and GRIFFIN, R. A. YIELD TESTS AND LAND VALUATION. Iowa Agr. Expt. Sta. Res. Bul. 252, pp. 53–76, illus. See p. 59.

land by causing gullying or by depositing silt on low-lying lands. If gullying occurs, the value of the land may be reduced more than the loss of topsoil indicates.

The value of the subsoil for farming purposes varies widely. Heavy, compact subsoil usually is poorly drained and prevents the best plant-root development. Soils having loose, gravelly or sandy subsoils usually are low in productivity. The most satisfactory subsoil for general farming is one of medium-fine texture, affording good drainage and aeration, and containing a liberal supply of plant-food elements. In some cases subsoils may be made productive and can be used for cropland if organic matter and fertilizers are applied. Such treatments, however, raise the cost of production on thin soils.

Estimates of the present and probable future value of the land cannot be made accurately, but the justification for an erosion-control program from the farmer's point of view often may depend on the extent of capital loss that will be incurred by a continuation of present practices.

When making estimates the farmer should consider the actual sale value of farms in the same area that have not been eroded seriously and the value of farms that have been eroded seriously. The difference may not be due entirely to erosion, because of the importance of factors other than soil productivity. A further indication of how large is the loss in value can be obtained by comparing the yields of an area where the topsoil has been removed with those of an area having considerable topsoil remaining. Care should be taken to see that these observations are made in areas of the same soil type and under conditions where soil loss is the principal variable.

With these facts in mind the farmer or planner must use his own judgment as to what the future value of the land will be if erosion is allowed to continue. It is generally advisable to consider fields or areas within fields separately, because the factors affecting their valuation may vary considerably.

Once the total decrease in value has been estimated for each area or field of a farm, it should be reduced to an annual-loss figure. This involves an estimate of the rate at which erosion is taking place, and a determination of how many years it will take for the remaining surface soil to be removed if the present cropping system is continued. Conservation surveys show the percentage of the surface soil that has been removed on various slopes. When this is divided by the number of years the land has been cultivated, an approximate annual rate of erosion may be obtained. If, for example, 75 percent of the topsoil has been removed from land that has been cropped for 75 years, then the average annual rate of erosion has been 1 percent. If the land has been farmed only 50 years, the average annual rate has been 1½ percent.

The average rate of erosion during the period of years that the land has been in cultivation may not represent adequately the present or anticipated rate expected from the continuation of present land use and cropping practices. Cropping practices may have changed many times during the period of cultivation, so that present losses may not be closely related to the degree and average rate of soil loss in the past. Even with the same cropping practices the rate of erosion tends to accelerate as the supply of organic matter is reduced and the lowered water-holding capacity increases surface run-off. Decreased moisture

and fertility result in reduced vegetal cover, which in turn tends to increase the rate of erosion.

Many important factors affect the rate of soil loss. Degree and length of slope, type of soil, kind of crop grown, method of tillage, and the quantity and intensity of precipitation, all influence soil loss in large measure. Consideration of these factors will aid in making a rough estimate of the annual loss in value resulting from soil erosion. Thus, if the farmer in the example given estimated that a continuation of present cropping practices would reduce the value of his 168-acre farm by $10 an acre over a period of 30 years, the calculated annual loss would be $1,680÷30, or $56. This annual loss of capital may seem small in comparison with large fluctuations in values resulting from other causes, but its cumulative effect over a period of years constitutes a very important influence on the real value of individual capital investment. The estimated annual loss in capital value resulting from soil erosion should be recorded as in summary table 12.

The fact that loss of capital because of soil erosion reflects the progressive lowering of the productivity of the soil should be kept in mind, because it means that the relative income possibilities of the farm also will decline steadily. Moreover, this annual capital loss represents only the loss borne by the owner of the land. There may be other costs of erosion that are borne by society as a whole; for example, the silt from a farm may contribute to the filling of stream beds and reservoirs and to increased flood damage. Society and groups of farmers must consider these other factors but it usually is impractical to allocate the cost of public damages to particular farms within a watershed.

Although the accuracy of estimates of capital loss consequent to soil erosion may be the deciding factors in many cases in determining the most desirable alternatives of land use and cropping practices, the best method now available seems to be to make a very rough estimate based on a composite judgment of the many factors influencing the change in soil productivity. This judgment is likely to result in a wide variety of conclusions by different individuals for a given set of conditions. If some method of weighting the influence of slope, soil type, land use, cropping practices, and other factors in soil productivity were devised, more nearly uniform and accurate results might be obtained.

One method of estimating the anticipated loss of capital by soil erosion caused by present farming methods is based on estimated changes in gross production of and income from crops and livestock. The estimated changes in gross income should be modified by anticipated changes in expense items that would be incurred in establishing erosion control, in order to obtain an estimated annual change in net income that might be capitalized in the calculation of annual capital loss arising from soil erosion. This would involve a need for information concerning yield trends for specific cropping systems for specific physical situations. While this method is very realistic as to the manner in which loss of capital values occur, little of the essential information is available for making the necessary computations.

Considerable work has been done at Ohio State University [6]

[6] Salter, R. M., Lewis, R. O., and Slipher, S. A. OUR HERITAGE—THE SOIL. Ohio State Univ., Agr. Ext. Bul. 175, 20 pp 1936

and University of Missouri [7] in relating annual losses of surface soil and soil productivity to conditions of land use, cropping practices, and degree and length of slope.

These indices of changes in soil productivity are not equally useful for all types of soil, but they do represent a definite contribution to the consideration of factors affecting soil productivity and resulting capital values. Another set of estimates of the percentage of the top 7 inches of soil lost annually by erosion resulting from differences in slope conditions, land use, and cropping practices, is shown by R. E. Uhland.[8] The latter indices of changes in soil productivity may be more widely applicable than those designed particularly for conditions in Ohio and Missouri.

Even after the relationship between physical conditions, land use factors, and soil productivity has been established, the change in productive capacity must be related to capital value. A 10-percent decline in productivity might mean a 20-percent decline in net income if farm costs remained the same or increased and there was no change in the size of the farm. In spite of obvious difficulties, the refinement of methods of estimating changes in soil productivity will be very useful in considering capital losses resulting from soil erosion.

Another method of estimating this annual capital loss is shown in table 10, using the Iowa example farm as an illustration. The farm consists of 168 acres and is valued at $40 per acre. The three major soil types found include 32 acres of Grundy silt loam, 70 acres of Tama silt loam, and 66 acres of Shelby loam. The farm has been under cultivation for approximately 75 years. The percentage of surface soil remaining can be calculated from the erosion survey map for the area, by subtracting the percentage of soil lost from 100 percent. Thus if 75 percent of the surface soil has been removed, 25 percent remains.[9] If the average rate of erosion of 1 percent per year were to continue, all the remaining surface soil would be removed in 25 years; if the rate were 1½ percent a year, the remaining soil would be gone in 17 years. If the difference between the present value of the land and the value of the subsoil were $25 per acre, the annual loss would be $1 per acre with 1 percent of erosion and $1.50 with erosion of 1½ percent.

[7] KLEMME, A. W., AND COLEMAN, O. T. EVALUATING ANNUAL CHANGES IN SOIL PRODUCTIVITY. Mo. Agr. Expt. Sta. Bul. 405, 32 pp. 1939.

[8] UHLAND R. E. QUANTITATIVE BASIS FOR EVALUATING EFFECTIVENESS AND APPLICATION OF SOIL CONSERVATION PRACTICES. Soil Conservation 5; 152–6. 1939.

[9] After the topsoil has been removed below plow depth a gradual mixing with the subsoil reduces this theoretical rate of removal of topsoil.

TABLE 10.—*Estimated annual capital loss resulting from continued soil erosion*

Field, pasture, or area	Size	Soil type	Topsoil removed	Topsoil remaining [2]	Years of cultivation	Annual rate of erosion [3]	Gullying (degree)	Period required to remove remaining topsoil	Present land use	Present value of soil per acre	Value of subsoil per acre	Capital loss per acre if all the topsoil remaining is removed [4]	Annual capital loss per acre [5]	Total annual capital loss [6]
	Acres		*Percent*	*Inches*	*Number*	*Percent*		*Years*		*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1A	24	Shelby loam	75	3	75	1	Medium	15	Crop	13	7	6	0.40	9.60
2C	8	do	65	4.2	75	.87	do	21	do	18	7	11	.52	4.16
3A	8	do	75	3	(?)		Slight		Permanent pasture.	13	7	6		
3B and 4A	18	Tama silt loam	50	8	(?)		do		do	52	12	40		
4B	20	Shelby loam	75	3	(?)		Severe		do	7	7	0		
2A and 5	24	Grundy silt loam	25	13.5	75	.33	None	200	Crop	68	7	61	.30	7.20
1B, 2B, 6, and 8	51	Tama silt loam	50	8	75	.67	Slight	65	do	52	12	40	.62	31.62
7	6	Grundy silt loam	35	11.5	75	.47	Medium	100	do	62	7	55	.55	3.30
Total	[1] 159													[7] 55.88

[1] Total acres in fields and pastures, 159; buildings, roads, and woodland, 9; total farm, 168 acres.

[2] These estimates cannot be made accurately for any large area, because of the great variations that occur; they indicate only the approximate average depth of the soil in a given field, field area, or pasture area.

[3] The annual rate of erosion is calculated by dividing the topsoil removed by the years of cultivation.

[4] The capital loss per acre resulting from the total loss of topsoil remaining is calculated by subtracting the value of the subsoil from the present value of the soil.

[5] The annual capital loss per acre is calculated by dividing the total capital loss if all the topsoil is removed by the years to remove the remaining topsoil.

[6] The total annual capital loss is obtained by multiplying the annual capital loss per acre by the acreage.

[7] This assumes that under the conservation plan the farm will remain on a permanently productive basis and no further capital loss from soil erosion will take place.

In table 10, this calculation is made for fields or combinations of fields, that have been grouped by soil type, land use, and degree of erosion. On fields seeded to permanent pasture, no further loss is anticipated. The key items are the figures for total capital loss if all the topsoil is removed and the number of years it will take for this loss to occur. Because gullying and accelerated erosion were important factors on some fields, it was estimated that future losses resulting from soil erosion would occur more rapidly in these fields than in the past, if no effort were made to check the erosion. Therefore, for fields in which severe gullying is a factor, the number of years until total loss would come have been reduced below the figure indicated by the percent of topsoil remaining and the past rate of erosion. The annual loss per acre on this farm ranged from nothing for permanent pasture to 62 cents. For the farm as a whole, the estimated capital loss amounted approximately to $56 per year. Assuming that the proposed system will prevent further losses from soil erosion,this item was entered in table 12 as an increase in net income.

One inherent difficulty in this method of estimating capital loss resulting from soil erosion is the breaking down of the present market value of land and buildings into a value per acre for specific fields. The valuation of the subsoil for agriculture is another difficult, although necessary, part of the calculation. However, the importance of a consideration of declining incomes and capital values resulting from soil erosion makes imperative the attempt to overcome even these major difficulties.

THE FINAL BALANCE

The final balance of changes in economy of the farm under the proposed system of farming should show two major items: (1) The estimated capital investments and changes in operating capital (table 11), and (2) the estimated net effect on annual income (table 12). Capital investments represent expenditures that are of a permanent nature and not easily changed. Operating capital represents the money to be used in the operation of the farm business, and this usually is more flexible. When these items have been estimated the best method of financing the proposed changes and the spreading of capital investments over the transition period can be considered. Some farmers may prefer to make a rapid change to the proposed system, while others may prefer to make the changes more slowly. In many cases the availability of credit or the extension of Federal assistance may be the deciding factors.

The estimates entered in table 11 show that the proposed system for this example farm will require a capital investment of $558 and an increase in operating capital of $465.80. On this particular farm almost all of these investments are to be made from current savings and money is to be borrowed only for the purchase of the cattle. The farmer decided to finance the system in the following order: 1st year, lime and fertilizer, additional seed out of saving in threshing cost; 2d year, structures and other permanent changes, increase in ewes by selling fewer lambs; and 3d year, erecting shed, purchasing stocker cattle.

TABLE 11.—*Estimated capital investment and net change in operating capital required under the proposed system*

Capital investments and changes in operating capital	Increase	Decrease
	Dollars	*Dollars*
Capital investments:		
Cost of lime and fertilizer, applied first year only (table 8)	144.00	
Cost of additional structures and other permanent changes (table 9)	414.00	
Other capital investments		
Total capital investment	558.00	
Changes in operating capital:		
Cost of lime and fertilizer, applied annually (table 8)	57.00	
Changes in investment in livestock (tables 2, 3, and 4):		
Sheep, 7 ewes	36.75	
Stocker beef cattle, 10 yearlings	375.00	
Other change in operating capital:		
Annual seed costs (table 6)	5.80	
Miscellaneous annual costs (oat harvesting) (table 7)		8.75
Total	474.55	8.75
Net change in operating capital	465.80	

As a result of the proposed changes in land use and livestock system, it is estimated that the annual income will be increased by approximately $80 if an amount equal to the previous annual loss in capital value caused by erosion is included as an annual gain (table 12). Even without this allowance for the prevention of capital loss, the farm would show an increase in net annual income of $24. However, the total labor requirements have been increased, and the operator will have less leisure time during the winter months.

It is expected of the proposed system that it will maintain the farm on a permanently productive basis, stabilizing its production at a new level. The production of total feed units and the net farm income probably will be increased and some small increase in land value may take place.

TABLE 12.—*Estimated effects of proposed system on annual net income*

Item	Increase	Decrease
	Dollars	*Dollars*
Net effect of changes in purchases and sales of crops, feeds, and livestock (table 4)	136.10	
Net change in cost of labor hired (table 5)		
Net change in annual seed cost (table 3)		5.80
Net change in annual harvesting and miscellaneous costs (table 7)	8.75	
Net change in annual costs of lime and fertilizer (table 8)		83.10
Annual amortization charge on capital investment (table 9)		31.50
Value of preventing annual capital loss caused by soil erosion (table 10)	55.88	
Total	200.73	120.40
Net effect on income	80.33	

While the proposed conservation program probably will increase present farm income and consequently raise present land values, the more important reason for its adoption is the obviation of a large capital loss and the continuing decline in current income resulting from soil erosion. The effects of continued erosion upon land values and income are cumulative. If on the example farm, erosion were permitted to deplete the land, unchecked, for another 10 years, the minimum capital loss would be more than $500, even if the effects of erosion were not accelerated, as is usual. The yields would decline steadily and the costs of controlling erosion would increase as the land became progressively more sheet-eroded and gullied.

APPENDIX

TABLE 13.—*Feed-unit equivalents of specific feeds* [1]

Kind	Quantity	Feed-unit equivalent	Kind	Quantity	Feed-unit equivalent
	Bushels	*Feed units*		*Tons*	*Feed units*
Corn	1	1.00	Legume hay	1	18.00
Oats	1	.50	Mixed hay	1	15.00
Barley	1	.75	Timothy hay	1	13.00
Wheat	1	1.00	Silage	1	6.50
Rye	1	.75	Corn stover	[2] 1	[2] 3.00
Soybeans	1	1.75	Oat straw	[3] 1	[3] 5.00
	Pounds			*Day*	
Protein concentrates	100	2.00	Pasture	1	.25

[1] A feed unit is that quantity of feed equivalent to the feeding value of 1 bushel of corn.
[2] Assuming that only 25 percent is eaten.
[3] Assuming that 50 percent is eaten.

Pasture-day equivalents

A pasture-day is that quantity of pasturage consumed in 1 day by the following animals:

1 mature cow or bull.
1 steer, over 2 years old.
2 yearling cattle.
4 weaned calves.
3 cattle on feed.
1 horse or mule.
2 colts, under 2 years old.
5 mature sheep.
10 weaned lambs.
4 brood sows.
15 spring or 15 summer pigs.

Labor used in caring for specific classes of livestock

Classes of livestock:	*Total man-hours per head per year* [1]	Classes of livestock:	*Total man-hours per head per year* [1]
Dairy cow	100	Horses	45
Beef-breeding stock	40	Sheep	2.5
Beef feeders	50	Hogs	2.5
Stocker cattle	40	Poultry (laying hens)	2.5

[1] These figures represent labor used under usual conditions for taking care of livestock. The quantity of labor used per head of livestock varies widely and the above figures should be modified to account for local or individual differences.

TABLE 14.—*Standard feed quantities for livestock* [1]

Type of livestock	Pasture days [2]	Corn	Oats	Protein concentrates	Legume hay	Other hay or roughage	Silage	Total feed units [3]
	Number	*Bushels*	*Bushels*	*Pounds*	*Tons*	*Tons*	*Tons*	*Number*
Work stock, 1 horse or mule or 2 colts under 2 years old:								
Lightweight or less than 800 hours work	140	20	25			2.25		95
Heavyweight or more than 800 hours work	40	50	40			3.00		116
Beef cattle, breeding herd:								
Without silage:								
Cow	180				0.75	1.50		77
Bull, mature	180	10	10		2.00			96
Heifer, yearling	90	5	8		1.50			59
Calf to 1 year	30	4	4		1.00			32
With silage:								
Cow	180				.50	.50	2.0	73
Bull, mature	180	10	10		1.50		1.5	97
Heifer, yearling	90	5	8		.50		2.0	54
Calf to 1 year	30	4	4		.75		.5	30
Stocker cattle, 200 pounds gain	60	5	8	30	.67	1.25		52
Fat unweaned calf, 10 months, 650 pounds	22	20	10	75	.06			33
Beef cattle, fattening:								
Without silage:								
Steer calves, 400 pounds gain		44		160	.60			58
Heifer calves, 350 pounds gain		39		140	.50			51
Yearling steers, 400 pounds gain		50		100	.60			63
Yearling heifers, 200 pounds gain		26		50	.40			34
2-year-old steers, 250 pounds gain		38		30	.50			48
With silage:								
Steer calves, 400 pounds gain		36		240	.25		1.50	55
Heifer calves, 350 pounds gain		32		210	.25		1.00	47
Yearling steers, 400 pounds gain		42		200	.25		1.25	59
Yearling heifers, 200 pounds gain		22		100	.20		.75	33
2-year-old steers, 250 pounds gain		30		100	.25		1.50	46
Dairy cattle:								
Without silage:								
Cows, under 5,000 pounds milk	180	12	13	100	2.50			111
Cows, 5,000 to 7,999 pounds milk	180	17	18	140	2.50			119
Cows, 8,000 pounds milk and over	180	24	25	200	2.50			131
Bull, mature	180	10	10	300	2.00			102
Heifer, yearling	90	8	8	250	1.50			69
Calf to 1 year	30	4	4	100	1.00			34
With silage:								
Cows, under 5,000 pounds milk	180	8	11	190	1.75		3.00	113
Cows, 5,000 to 7,999 pounds milk	180	11	13	260	1.75		3.00	119
Cows, 8,000 pounds milk and over	180	15	17	375	1.75		3.00	127
Bull, mature	180	10	10	300	1.50		1.00	100
Heifer, yearling	90	8	8	250	1.25		1.00	69
Calf to 1 year	30	4	4	100	.75		.50	32
Sheep:								
Breeding ewes and rams	36	1	2		.25			16
Early lambs, 5 months, 75 pounds		¾	1	20	.05			26
Late lambs, 7 months, 90 pounds	9	1	2		.025			5
Western lambs, 30 pounds gain	9	1	2		.025			5
Western lambs, 25 pounds gain, dry lot		2	1		.075			4
Hogs, including feed for breeding stock:								
Spring and summer pigs, 225 pounds	10	15	2	70	.002			20
Fall and winter pigs, 225 pounds		16	3	90	.020			20
Poultry:								
100 hens for 1 year	[4] 32	64	56	800				140
100 pullets to laying age	[4] 8	18	19	400				44
100 chicks to 12 or 16 weeks	[4] 3	7	6	225				18
100 turkeys, semi-range	16	32	35	1,250	.25			95

[1] Applicable principally in the Corn Belt. Use locally adapted data where available.
[2] Pasture-day is equivalent to pasture consumed in 1 day by a mature cow.
[3] Feed-unit equivalent to 1 bushel of corn.
[4] Bushels wheat.

TABLE 15.—*Probable range of substitution between roughage and grain in feeding specific classes of livestock* [1]

Class of livestock	Least utilization of forage		Greatest utilization of forage	
	Feed units from—		Feed units from—	
	Grain	Hay and pasture	Grain	Hay and pasture
	Percent	*Percent*	*Percent*	*Percent*
Dairy cow	28	72	12	88
Beef cow	12	88	4	96
Beef cattle, fattening	80	20	65	35
Lamb	33	67	18	82
Hogs, 200 pounds	89	11	80	20
Mature work horses	50	50	39	61

[1] Based upon experimental data from the animal husbandry section of Iowa State College of Agriculture.

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